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(54) **HEAD FEEDING MECHANISM HAVING PROTRUSION ENGAGED WITH LEAD SCREW**

(75) Inventors: **Kazuya Tamura**, Isehara (JP); **Yoshinori Tangi**, Hachiouji (JP); **Eiichi Yoneyama**, Atsugi (JP); **Hiromi Inoguchi**, Tama (JP)

(73) Assignee: **Mitsumi Electric Co., Ltd.**, Tokyo (JP)

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(51) **Int. Cl.**^{7} **G11B 21/08**
(52) **U.S. Cl.** **360/261.3**
(58) **Field of Search** 360/261.3

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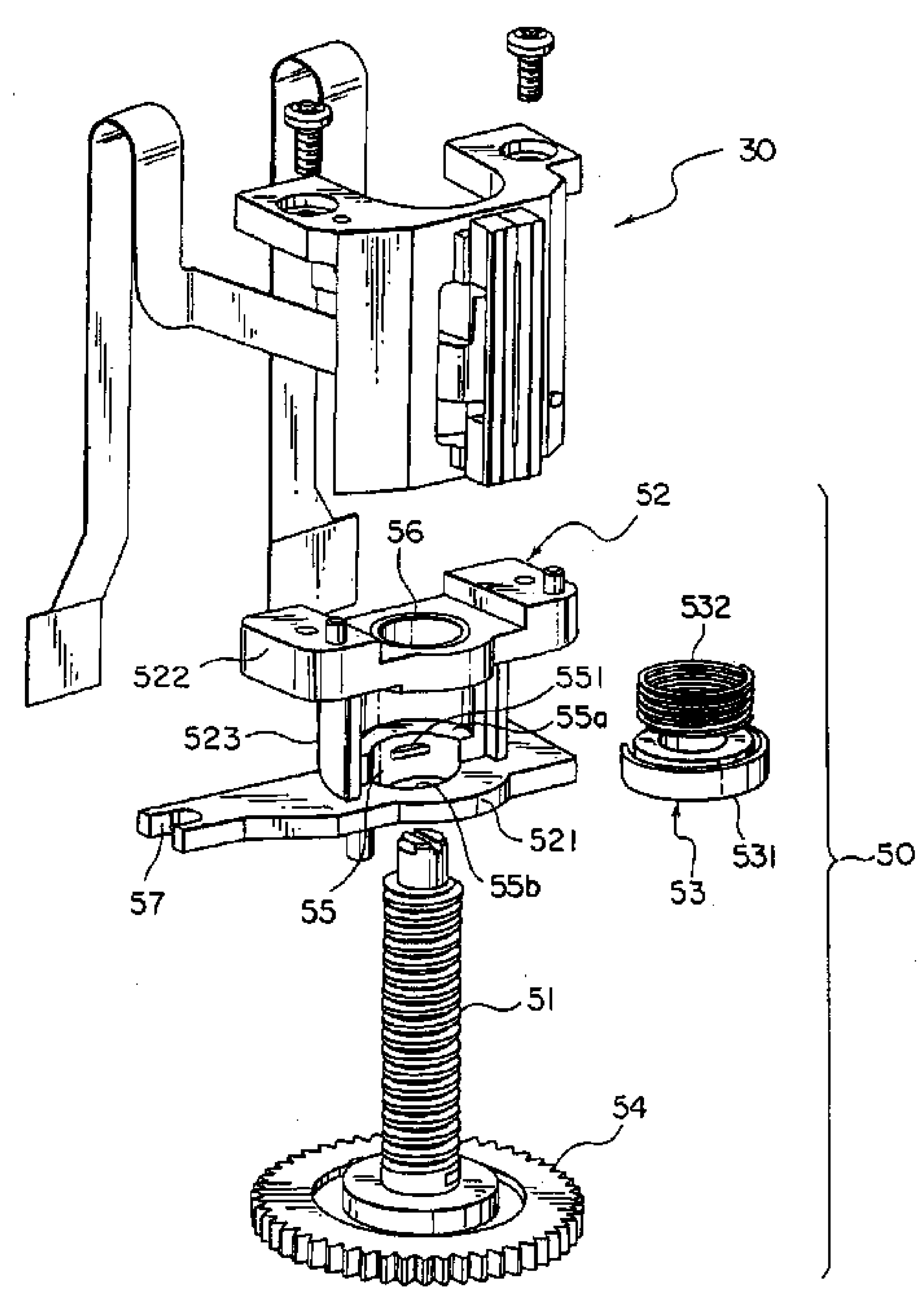
Primary Examiner—David Davis
(74) *Attorney, Agent, or Firm*—Frishauf, Holtz, Goodman & Chick, P.C.

(57) **ABSTRACT**

In the engaging structure of a lead screw (**51**) with a head lift body (**52**), for simplification of a feeding side mechanism and improvement of feeding accuracy, the head lift body has only one fingernail shaped protrusion (**551**) as a member engaging with an external thread of the lead screw (**51**). The protrusion (**551**) is provided on an internal wall surface of a bearing portion (**55**) formed in an integral structure with the head lift body (**52**). Accordingly, the engagement of the external thread of the lead screw and the single protrusion converts the rotation movement of the lead screw (**51**) to the linear movement of the head lift body (**52**). As a result, a feeding accuracy in the linear movement converted from the rotation movement is only determined by a feeding accuracy of only the lead screw (**51**). In an example, the protrusion is a half-moon shaped plate.

9 Claims, 8 Drawing Sheets



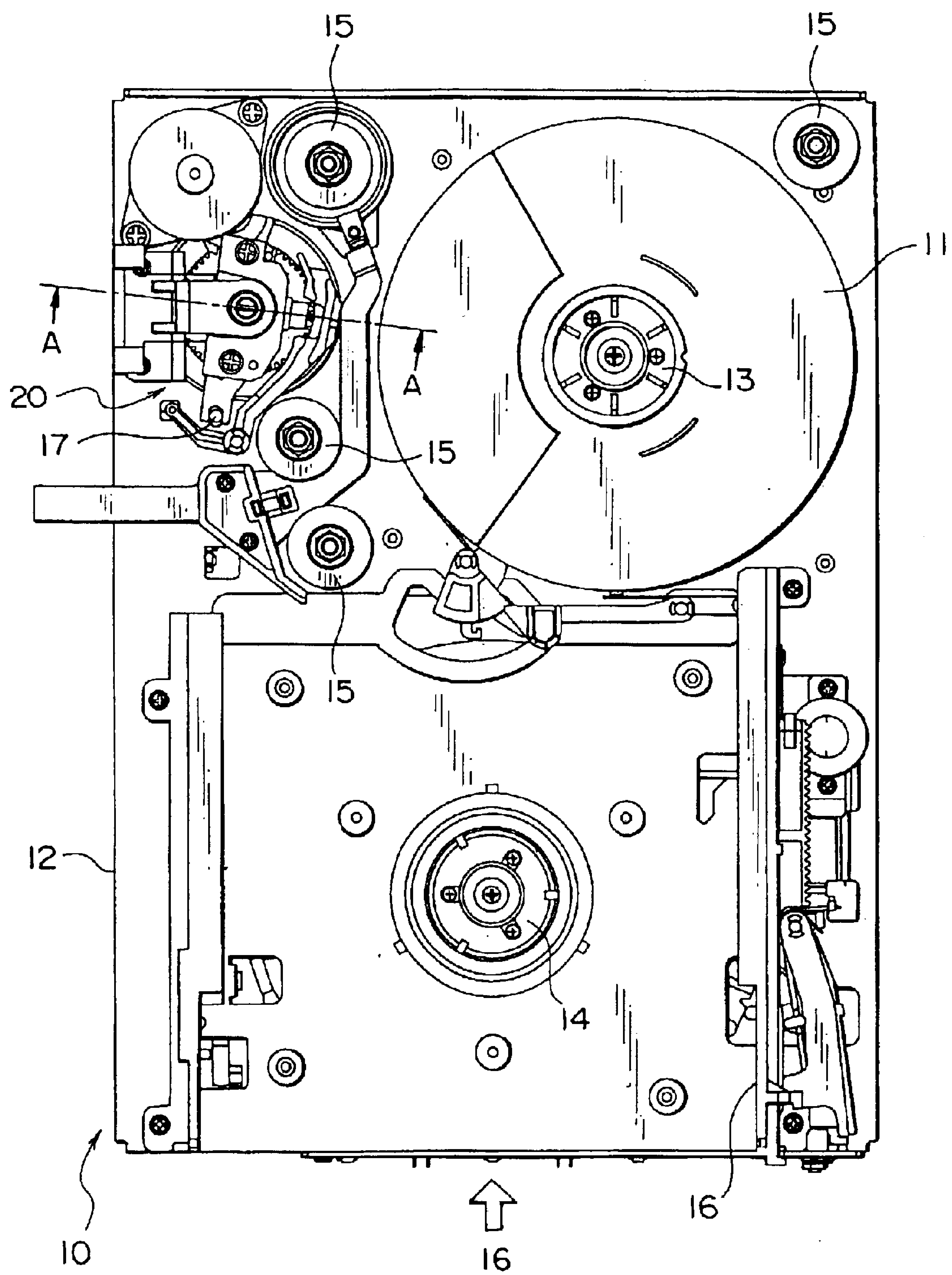


FIG. 1

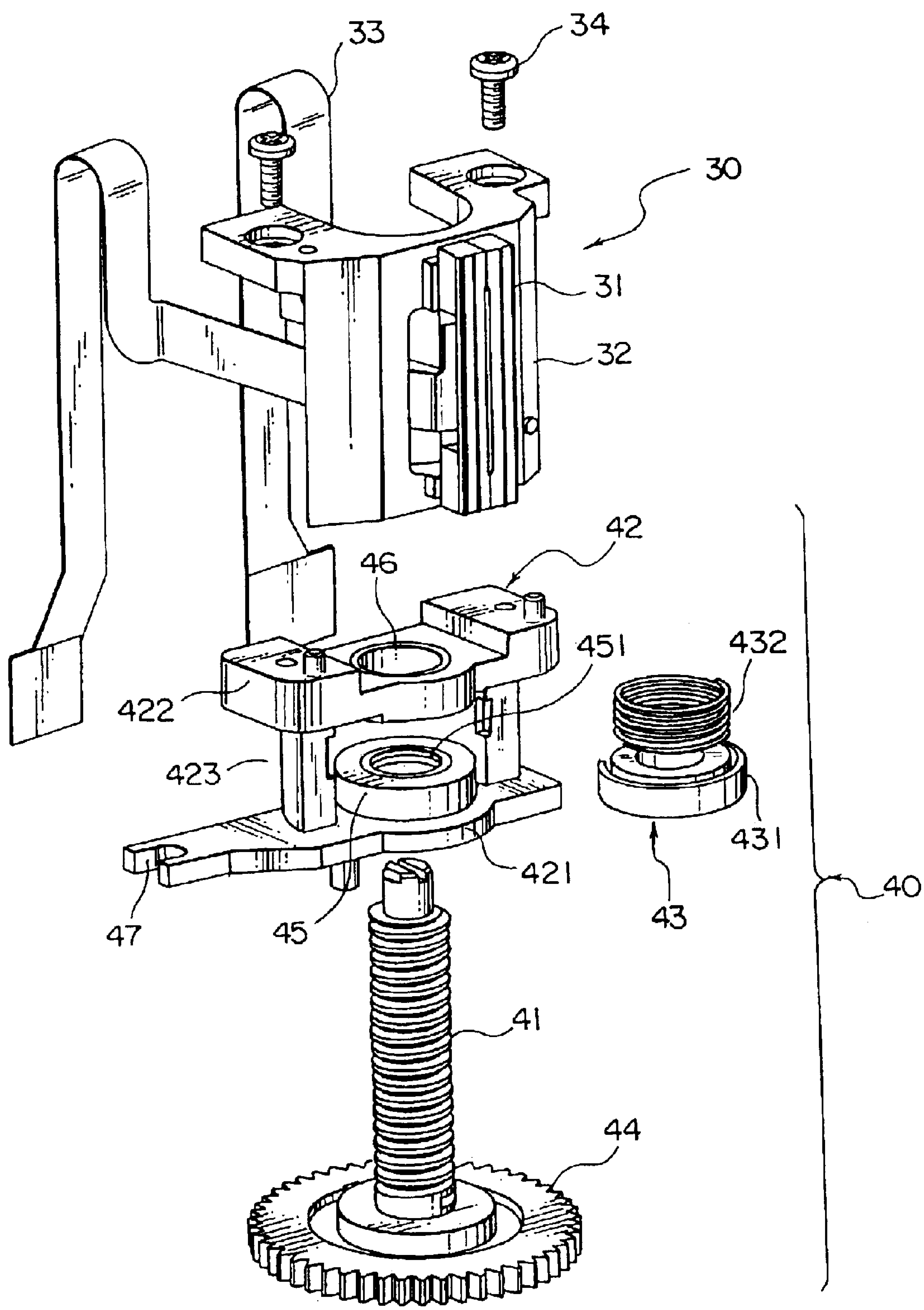


FIG. 2
PRIOR ART

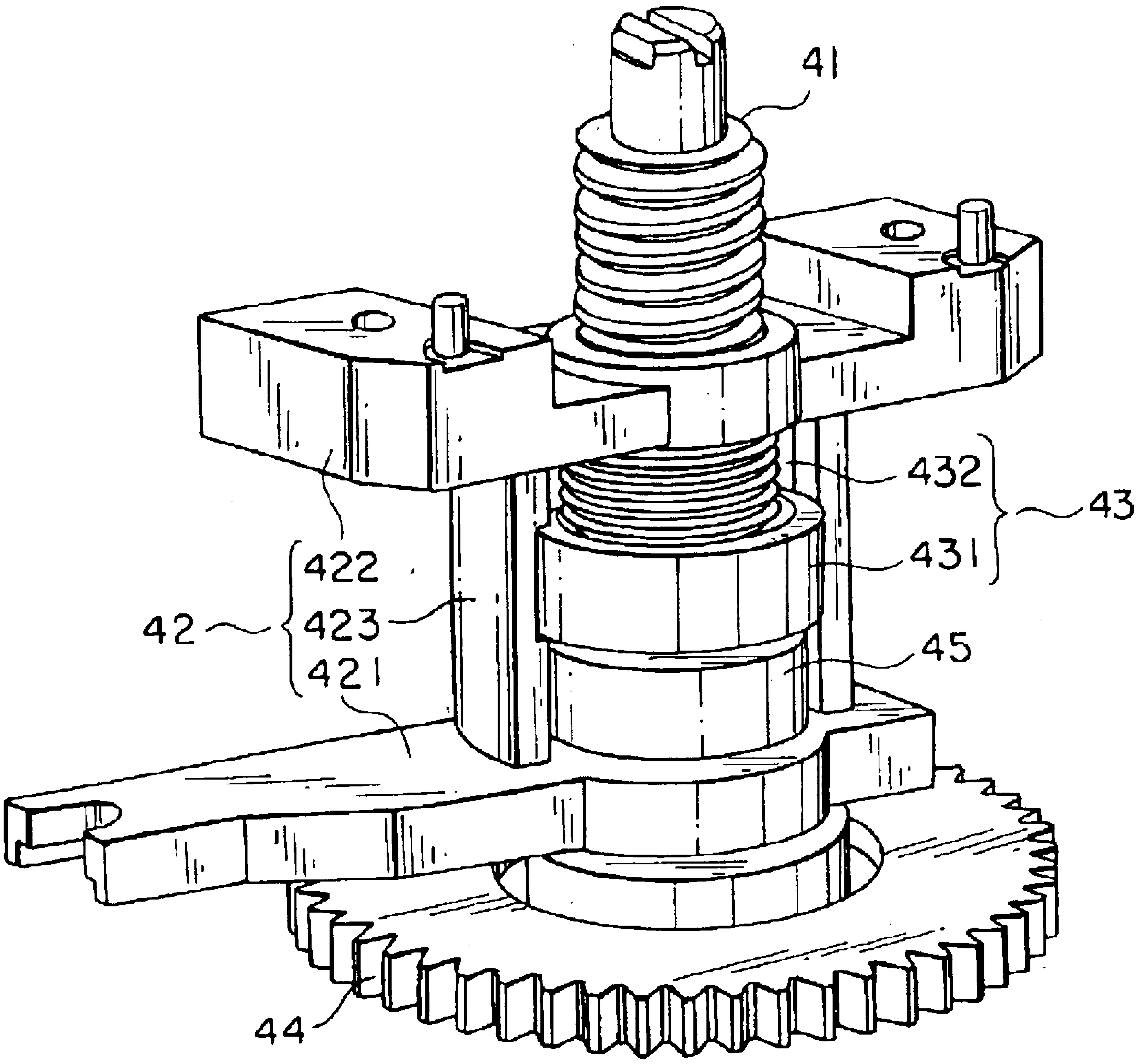


FIG. 3
PRIOR ART

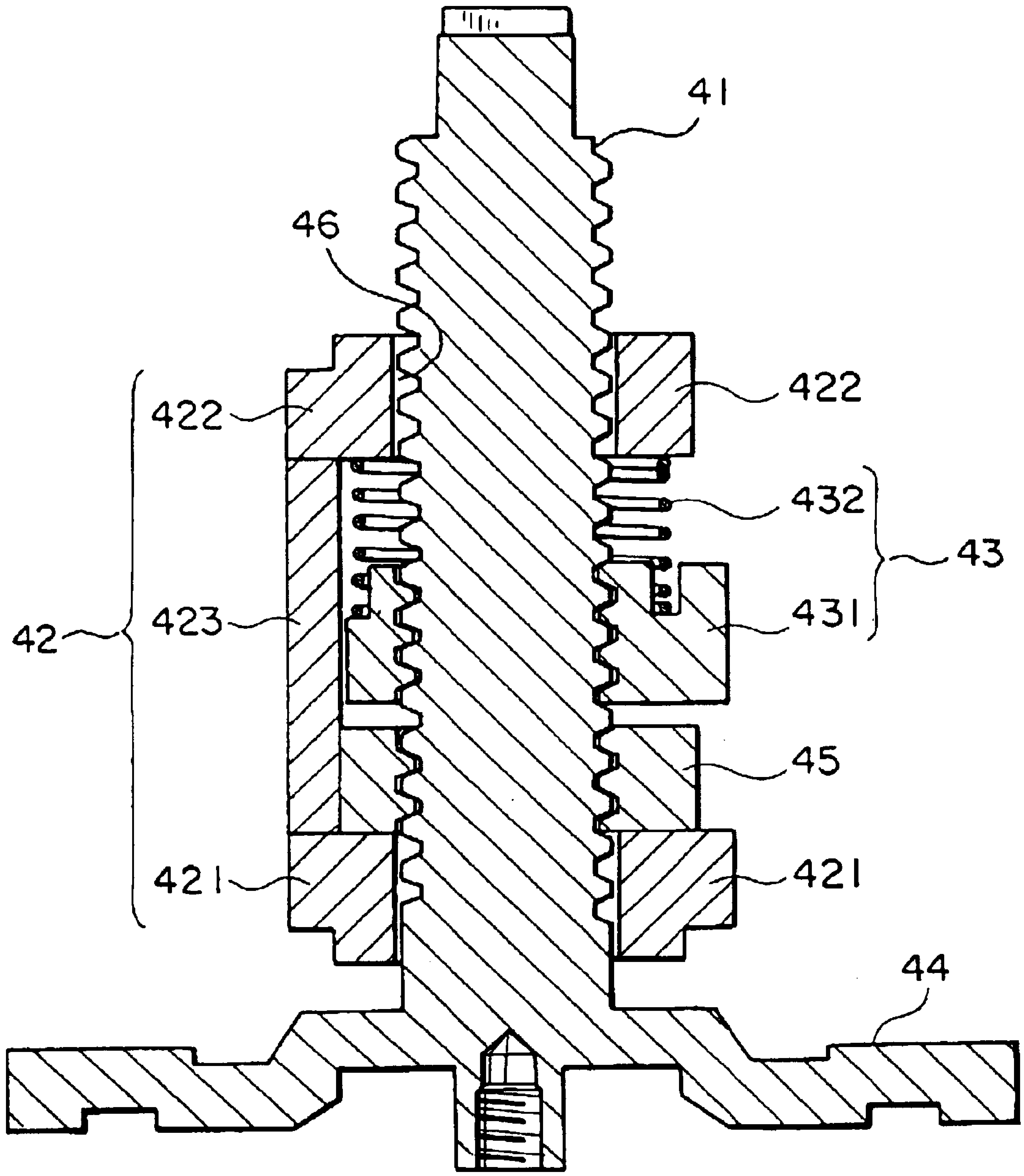


FIG. 4
PRIOR ART

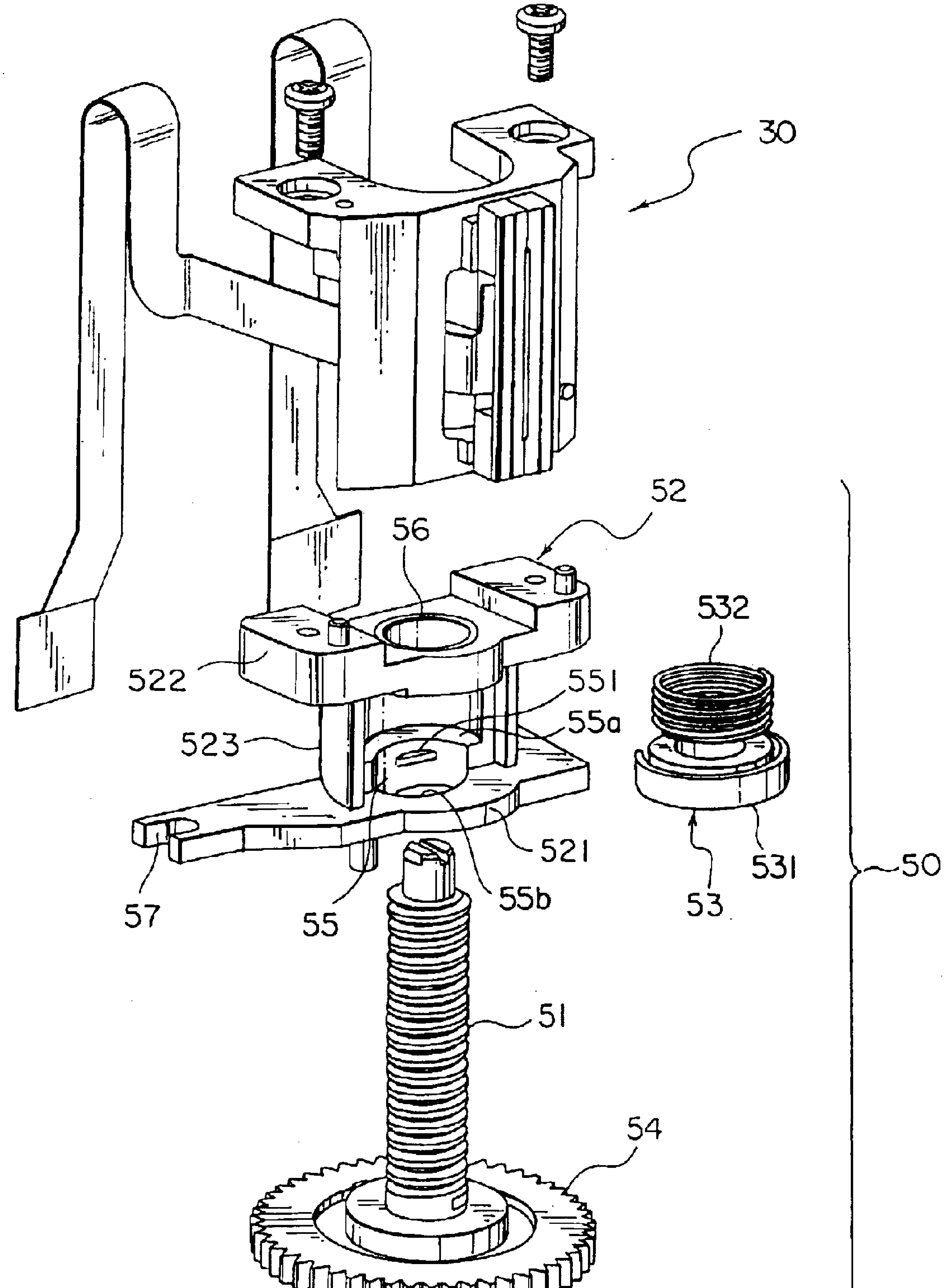


FIG. 5

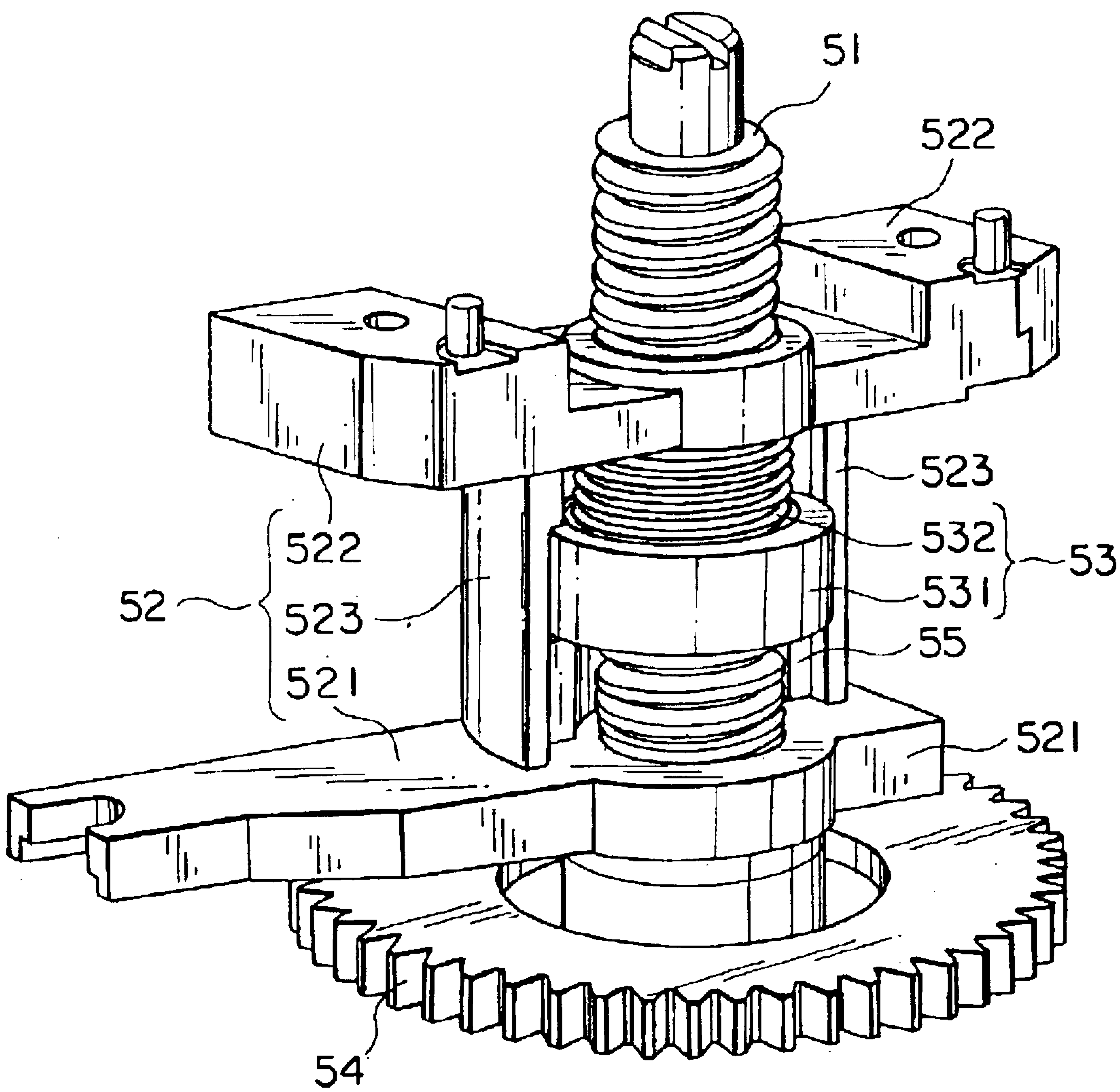


FIG. 6

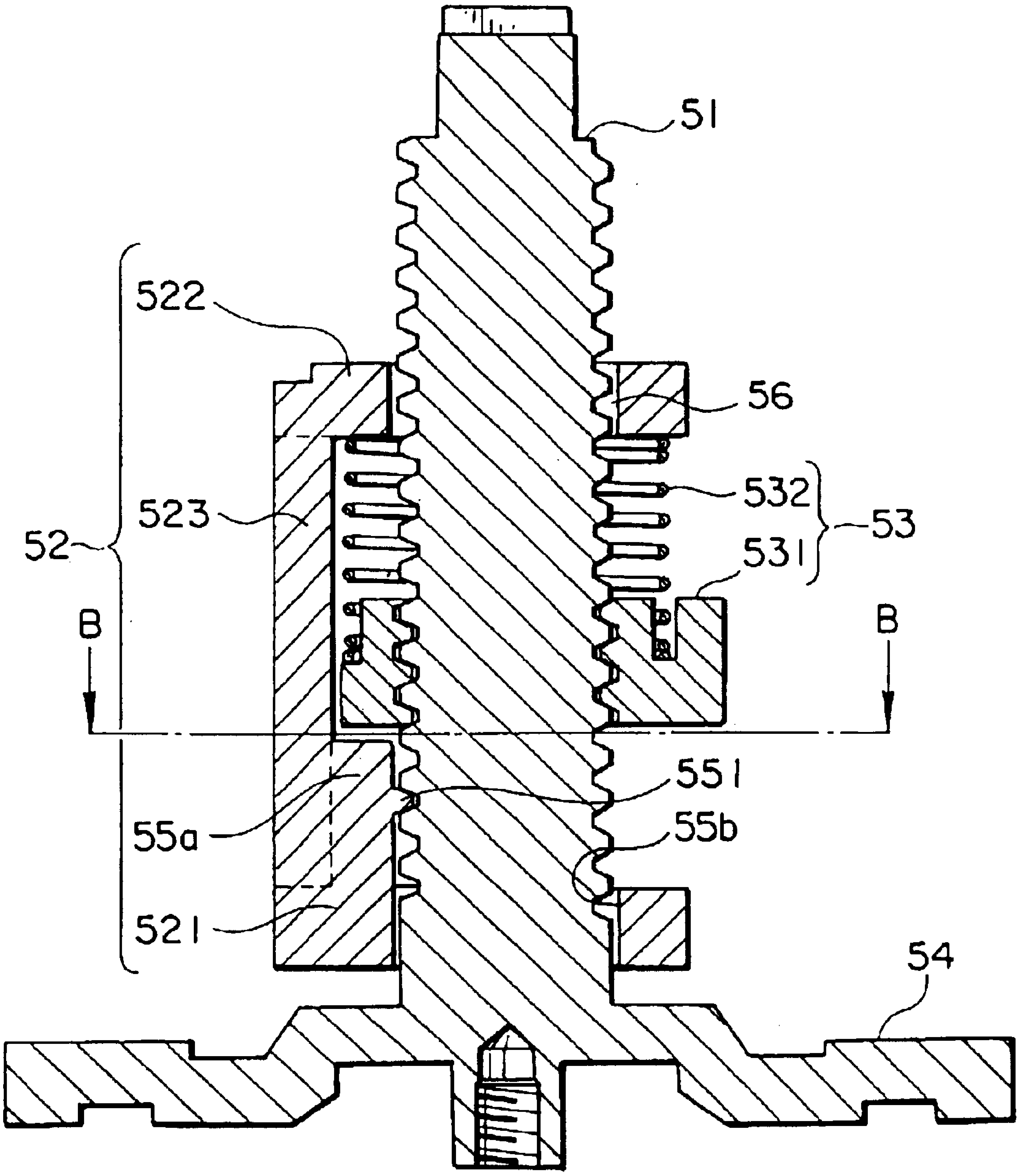


FIG. 7

FIG. 8

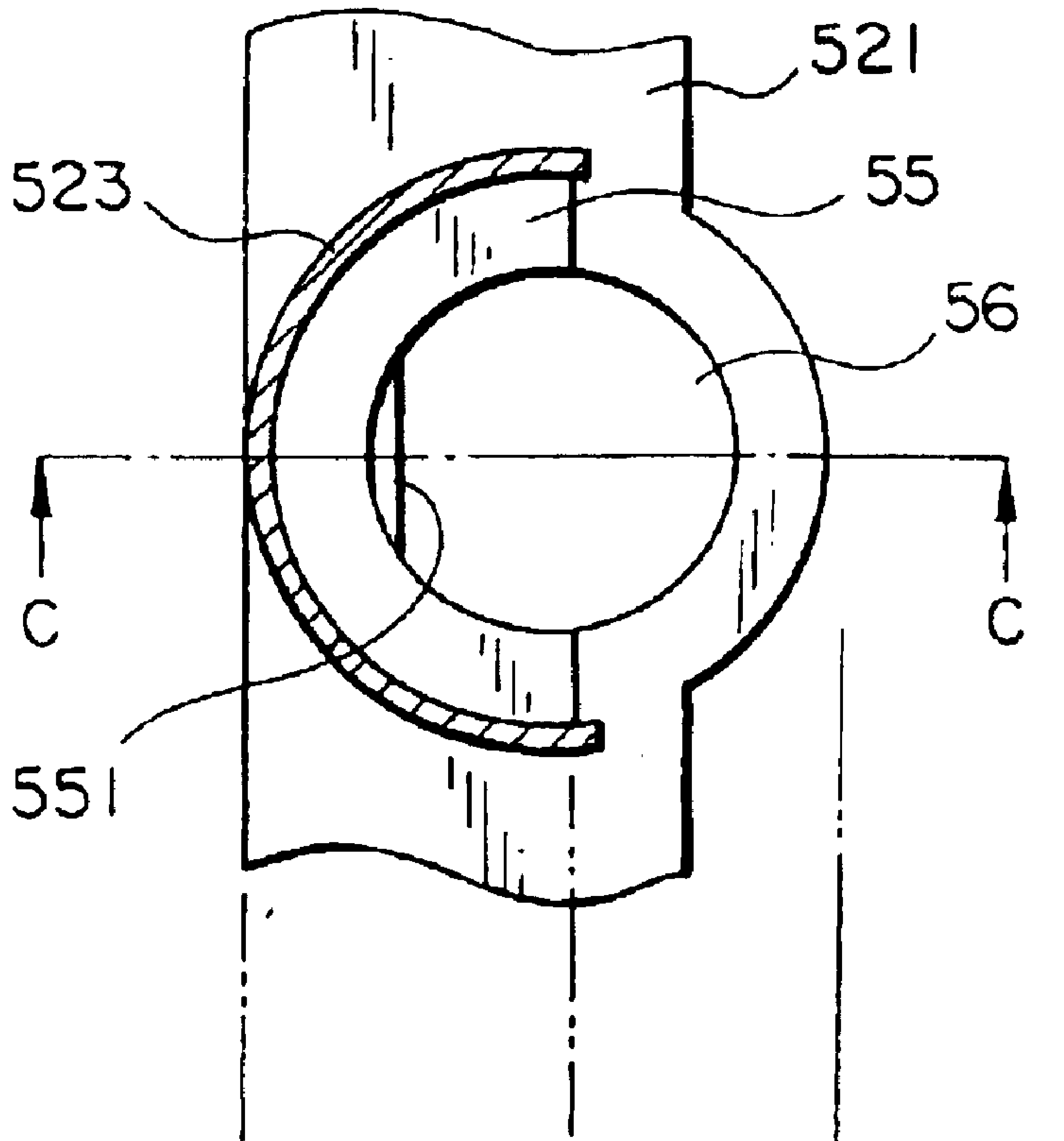
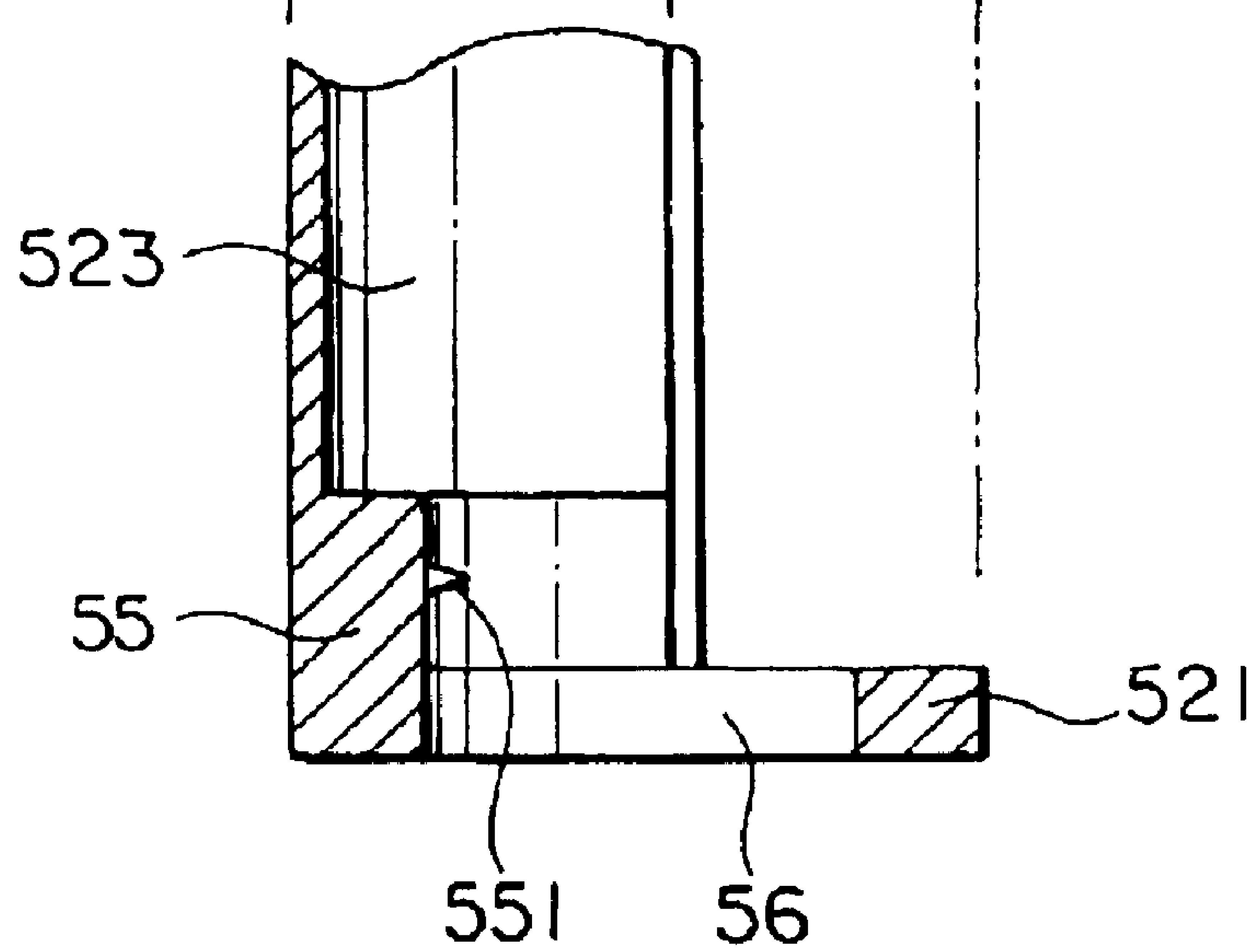


FIG. 9



HEAD FEEDING MECHANISM HAVING PROTRUSION ENGAGED WITH LEAD SCREW

This application claims priority to prior application JP 2001-399124, the disclosure of which is incorporated herein by reference.

BACKGROUND OF THE INVENTION

This invention relates to a head feeding mechanism of a magnetic head actuator assembly for use in a linear magnetic tape storage system represented by a DLT (digital linear tape) or an LTO (linear tape open) and, in particular, to a head feeding mechanism capable of simplification of a shape form in the feeding side and improvement of the feeding accuracy thereof.

A linear magnetic tape storage system (magnetic recording/reproducing apparatus) of the type has been developed as a backup for a memory device (e.g. a hard disk) of a computer system. Various types of linear magnetic tape storage systems have already been proposed. For example, a digital linear tape drive as a DLT is disclosed in U.S. Pat. No. 5,862,014.

The digital linear tape drive (which may simply be called "tape drive") is adapted to receive a tape cartridge having a single reel (supply reel) and contains a take-up reel in the interior thereof. When the tape cartridge is loaded in the tape drive, a magnetic tape is pulled out of the tape cartridge and taken up by the take-up reel through a head guide assembly (HGA). The head guide assembly serves to guide the magnetic tape pulled out of the tape cartridge to a magnetic head. The magnetic head exchanges information between the magnetic tape and the magnetic head. The head guide assembly generally comprises a boomerang-shaped aluminum plate and six large guide rollers each of which comprises a bearing.

The head guide assembly is also called a tape guide assembly and is disclosed, for example, in U.S. Pat. No. 5,414,585. An example of the guide roller is disclosed in Japanese Unexamined Patent Publication No. 2000-100025 (JP 2000-100025 A).

As disclosed, for example, in U.S. Pat. No. 5,793,574, the tape drive is generally comprised of a rectangular housing that has a common base. The base has two spindle motors (reel motors). The first spindle motor has a spool (take-up reel) permanently mounted on the base. The spool is dimensioned to accept a relatively high speed streaming magnetic tape. The second spindle motor (reel motor) is adapted to accept a removable tape cartridge. The removable tape cartridge is manually or automatically inserted into the drive via a slot formed on the drive's housing. Upon insertion of the tape cartridge into the slot, the tape cartridge engages with the second spindle motor (reel motor).

Prior to rotation of the first and the second spindle motors, the tape cartridge is connected to the permanently mounted spool (take up reel) by means of a mechanical buckling mechanism. A number of rollers (guide rollers) are positioned intermediately between the tape cartridge and the permanently mounted spool, and guide the magnetic tape as it traverses at relatively high speeds back and forth between the tape cartridge arid the permanently mounted spool.

The digital linear tape drive having the above-mentioned structure requires a pulling apparatus for pulling the magnetic tape from the supply reel to the take-up reel. Such a pulling apparatus is disclosed, for example, in International Publication No. WO 86/07471. According to WO 86/07471, take up leader means (first tape leader) is coupled to the take-up reel while supply tape leader means (second tape leader) is fixed to the tape on the supply reel. The first tape leader has a mushroom-like tab formed at its one end. The second tape leader has a locking hole. The tab is engaged with the locking hole.

Furthermore, a mechanism for joining the first tape leader to the second tape leader is required. Such a joining mechanism is disclosed, for example, in International Publication No. WO 86/07295.

Japanese Unexamined Patent Publication No. 2000-100116 (JP 2000-100116 A) discloses "Structure of Leader Tape Engaging Part". In this structure, an end of a leader tape (second tape leader) can be locked to a tape end hooking part of a tape cartridge without requiring a tab projecting on a lateral side of the leader tape.

U.S. Pat. No. 5,857,634 discloses a locking system for preventing the rotation of a take-up reel of a tape drive when a tape cartridge is not inserted into the drive.

On the other hand, an example of the tape cartridge to be received in the digital linear tape drive is disclosed in Japanese Unexamined Patent Publication No. 2000-149491 (JP 2000-149491 A).

U.S. Pat. No. 6,241,171 discloses a tape drive in which a tape leader can be urged from a tape cartridge through a tape path to a take-up reel without using a buckling mechanism or a take-up leader.

The tape drive further comprises a magnetic tape head actuator assembly. The magnetic tape head actuator assembly is positioned between the take-up spool and the tape cartridge along a tape path defined by a plurality of rollers. During operation, the magnetic tape streams back and forth between the take-up spool and the tape cartridge, coming into close proximity to the magnetic head actuator assembly while streaming along the defined tape path. An example of such a magnetic tape head actuator assembly is disclosed in the above-mentioned U.S. Pat. No. 5,793,574.

Referring to FIG. **1**, description will be made of the structure of a typical tape drive comprising a magnetic head actuator assembly. FIG. **1** is a plan view of the tape drive in the state where an upper cover is removed.

The tape drive **10** is adapted to receive a removable tape cartridge (not shown) and includes a take-up reel **11** in the interior thereof. The take-up reel **11** may be called a spool. The tape drive **10** comprises a generally rectangular housing (gear chassis) **12** having a common base. The base of the housing **12** has two spindle motors (reel motors) **13** and **14**. The first spindle motor **13** has the take-up reel **11** permanently mounted to the base. The take-up reel **11** is dimensioned so as to accept a magnetic tape (not shown) streaming at a relatively high speed. The second spindle motor **14** is adapted to receive the removable tape cartridge. The removable tape cartridge is manually or automatically inserted into the tape drive **10** via a slot **16** formed on the housing **12** of the tape drive **10** along the extending direction of the slot **16**.

When the tape cartridge is inserted into the slot **16**, the cartridge is engaged with the second spindle motor **14**. Prior to rotation of the first and the second spindle motors **13** and **14**, the tape cartridge is connected to the permanently mounted take-up reel **11** by means of a mechanical buckling mechanism. A number of rollers (guide rollers) **15** are positioned between the tape cartridge and the take-up reel **11** and guide the magnetic tape as it streams at a relatively high speed back and forth between the tape cartridge and the permanently mounted take-up reel **11**.

The housing **12** is made of aluminum die-casting, which is a non-magnetic material. Accordingly, the second spindle motor **14** is covered with a plate of an iron-based magnetic material in order to inhibit magnetic leakage from a magnet (not shown) of the second spindle motor **14**.

The tape drive **10** further comprises a magnetic tape head actuator assembly (hereinafter may be simply called "actuator assembly") **20**. The actuator assembly **20** is positioned between the take-up reel **11** and the tape cartridge along a tape path (not shown) defined by the rollers **15**. During operation, the magnetic tape streams back and forth between the take-up reel **11** and the tape cartridge, coming into close proximity to the actuator assembly **20** while streaming along the defined tape path.

Next, referring to FIGS. **1** and **2**, description will be made of an outline of the actuator assembly **20**. As shown in FIG. **2**, the actuator assembly **20** comprises the head assembly **30** and the head feeding mechanism **40**. And the head feeding mechanism **40** comprises a rotation portion and a linear movement portion moving up and down in a direction of a rotation axis of the rotation portion.

The actuator assembly **20** is disposed on the base of the housing **12** and has a magnetic head assembly **30** moving along and in proximity of a magnetic tape surface. On the base of the housing **12**, a guide bar **17** is fixedly mounted to guide the magnetic head assembly **30** moving up and down linearly in a vertical direction or a direction perpendicular to the base of the housing **12**.

The magnetic head assembly **30** comprises a magnetic head **31** extending in the vertical direction, a head holder **32** holding the magnetic head **31** on its one side surface (hereinafter may be called "front surface"), and a pair of flexible printed circuits (hereinafter may be abbreviated to "FPC") **33**. The FPCs **33** extend at the opposite side surface (hereinafter may be called "rear surface") to electrically connect the magnetic head **31** and an external circuit (not shown). By screwing screws **34** to a head lift body **42** of the head feeding mechanism **40** through the screw holes, the head assembly **30** is coupled to the head lift body **42** of the head feeding mechanism **40**.

On the rear side of the head holder **32**, the head feeding mechanism **40** is disposed with a lead screw **41** having a screw center axis as a rotation center axis extending in the vertical direction. The head lift body **42** is engaged with the lead screw **41** and moves up and down together with the head assembly **30** following the rotation of the lead screw **41**.

Next, description will be made of the head feeding mechanism **40** shown in FIG. **2**.

The head feeding mechanism **40** comprises the lead screw **41** with an external thread, the head lift body **42**, and a backlash preventing mechanism **43** for preventing the backlash of the actuator assembly **20**.

The lead screw **41** has a rotation center axis extending in the vertical direction and is provided with a lead screw gear **44** attached to a lower end thereof. The lead screw gear **44** serves to rotate the lead screw **41** around the rotation center axis when it is driven by a driving machine (not shown). The head lift body **42** moves up and down along the rotation center axis following the rotation of the lead screw **41** around the rotation center axis.

The head lift body **42** comprises a base portion **421**, a ceiling portion **422**, and a semi-cylindrical portion **423**. The base portion **421** and the ceiling portion **422** extend substantially in parallel to each other and are spaced in the vertical direction and connected to each other by the semi-cylindrical portion **423**. The semi-cylindrical portion **423** has an upright gutter-like shape as a half-split cylinder, which is taken by cutting a hollow cylinder by a plane along the center axis thereof. Accordingly, the head lift body **42** has a generally "I" shape as seen from a lateral side. The head lift body **42** holds the head assembly **30** and moves up and down together with the head assembly **30**. In the head lift body **42**, the backlash preventing mechanism **43** is arranged inside of the hollow opening of the semi-cylindrical portion **423**.

The backlash preventing mechanism **43** includes a pre-load bushing **431** and a pre-load spring **432** of a compression coil spring. The pre-load bushing **431** has an internal thread to be engaged with the external thread of the lead screw **41** when the pre-load bushing **431** is located in the hollow opening of the semi-cylindrical portion **423**. The pre-load spring **432** is disposed in a compressed state between the head lift body **42** and the pre-load bushing **431**.

The lead screw gear **44** is fixed to the lower end of the lead screw **41** and serves to rotate the lead screw **41** around the rotation center axis when it is driven by a driving machine (not shown). The lead screw **41** is engaged with an internal thread **451** of a nut **45** mounted on the head lift body **42**. Accordingly, the rotation of the lead screw **41** around the rotation center axis thereof moves the head lift body **42** in the vertical direction coincident with the extending direction of the rotation center axis, in cooperation with the pre-load bushing **431**.

Next, description will be made of the structure of the head lift body **42** more in detail.

The head lift body **42** includes the nut **45**, which has the internal thread **451** to be engaged with the lead screw **41**, a plain or sliding bearing **46** (will later be described), and a guide portion **47** (will later be described).

As described above, the head lift body **42** has a main portion composed of the base portion **421** defining a lower end surface, the ceiling portion **422** defining an upper end surface, and the semi-cylindrical portion **423** with the hollow opening. Each of the base portion **421** and the ceiling portion **422** has a pair of peaks extending outward from opposite sides of the semi-cylindrical portion **423**. As seen in a direction perpendicular to the extending direction of the peaks, i.e., as seen from the lateral side, the head lift body **42** has a generally "I" shape. The base portion **421** and the ceiling portion **422** have circular openings formed at positions corresponding to the hollow opening of the semi-cylindrical portion **423** to form the plain or sliding bearings **46**, respectively, which receive the lead screw **41** inserted therethrough.

At the position of the above-mentioned circular opening to receive the lead screw **41** inserted therethrough and in the hollow opening of the semi-cylindrical portion **423**, the base portion **421** is provided with the nut **45** having the internal thread **451** to be engaged with the lead screw **41**. In the figure, the nut **45** is fixedly mounted on the upper surface of the base portion **421** in the hollow opening of the semi-cylindrical portion **423**. Alternatively, the nut **45** may be integrally molded, for example, embedded in the base portion **421** at that position.

One of the peaks of the base portion **421** laterally extends as an arm to the length longer than the other peak and has the guide portion **47** of a generally "U" shape at its end. The guide portion **47** is fitted and attached to the guide bar **17** illustrated in FIG. **1** so as to be slidable in the vertical direction. The guide portion **47** serves to prevent the rotation of the head lift body **42** around the rotation central axis.

The ceiling portion **422** has a pair of screw holes in its peaks engaged with the screws **34**, respectively. By screwing the screws **34** into the screw holes, the head assembly **30** is fixed to the head lift body **42**. The hollow opening of the semi-cylindrical portion **423** serves to receive the backlash preventing mechanism **43** comprising the pre-load bushing **431** and the pre-load spring **432**.

That is, the backlash preventing mechanism **43** comprises a combination of the pre-load bushing **431** and the pre-load spring **432**, and serves to prevent backlash of the actuator assembly **20**.

The pre-load bushing **431** comprises a cylindrical portion with an internal thread formed on its inside surface, an external annular receiving portion, and a semi-cylindrical wall portion. The external annular receiving portion extends radially outward at the lower end of the cylindrical portion to serve as a stopper for the pre-load spring **432**. The semi-cylindrical wall portion extends upward from an outer periphery of the receiving portion in an area corresponding to an approximately half circle. Accordingly, a semi-annular gap is formed between the cylindrical portion and the semi-cylindrical portion. As shown in FIG. **4**, the pre-load spring **432** is partially received in the semi-annular gap and is disposed in a compressed state between the annular receiving portion of the pre-load bushing **431** and the lower surface of the ceiling portion **422** of the head lift body **42**. Furthermore, both ends of the semi-cylindrical wall portion of the pre-load bushing **431** inhibit the rotation of the pre-load bushing **431** by engagement with edges of the semi-cylindrical portion **423** when the pre-load bushing **431** is mounted into the head feeding mechanism **40**.

The pre-load spring **432** is a compression coil spring. By mounting the pre-load spring **432**, the pre-load bushing **431** is continuously applied with a downward pressing force along the rotation center axis of the lead screw **41**, while the head lift body **42** is continuously applied with an upward pressing force along the rotation center axis of the lead screw **41**. As the guide portion **47** is integrally formed with the head lift body **42**, the guide portion **47** is continuously applied with the upward pressing force along the rotation center axis of the lead screw **41**, also.

Accordingly, the above backlash preventing mechanism **43** is capable of preventing backlash between the lead screw **41** and the head lift body **42** during movement following the rotation of the lead screw **41**.

The head feeding mechanism **40** described above is insufficient in accuracy for feeding the head lift body **42** to the direction of the rotation axis of the lead screw **41** during movement following the rotation of the lead screw **41**. This causes some trouble to impede the magnetic head **31** to accurately trace each track on the magnetic tape.

The reason is that the external thread of the lead screw **41**, the tooth of the lead screw gear **44**, and the internal thread **451** of the nut **45** are different from each other in shapes and accuracy. Accordingly, positioning of the magnetic head **31** moved cannot be performed at same spaces.

Recently, it has been attempted to increase a number of tracks for increase of storage capacity of data on a magnetic tape and it is, therefore, required to make tracks with narrow and same spaces between the tracks. Accordingly, it could not avoid that any off-track occurs because of some margin of error during reproducing data from the magnetic tape which records the data at same track spaces.

SUMMARY OF THE INVENTION

It is therefore an object of this invention to provide a head feeding mechanism, which is capable of simplification of a shape form in the feeding side of a magnetic tape and improvement of feeding accuracy thereof.

This invention relates to a head feeding mechanism **(50)** which is coupled with a magnetic head assembly **(30)** movable on a housing **(12)** in a linear direction and is adapted to move the magnetic head assembly **(30)** linearly in a guide axial direction of a guide bar **(17)** arranged on the housing **(12)**. And the head feeding mechanism **(50)** has a screw center axis as a rotation center axis extending parallel in the guide axial direction of the guide bar **(17)**. The head feeding mechanism **(50)** comprises a lead screw **(51)** provided with an external thread, a head lift body **(52)**, and a backlash preventing mechanism **(53)**.

The head lift body **(52)** has a through hole for receiving the lead screw **(51)** inserted therethrough and forms a hollow opening at its center, and has an integral structure formed by resin molding with a guide portion **(57)** for restricting the head lift body **(52)** from rotating around the rotation center axis and for moving linearly the head lift body **(52)** along the rotation center axis, and a bearing **(55)** to be engaged with the lead screw **(51)**. And the head lift body **(52)** is fixed to the magnetic head assembly **(30)**.

The above bearing **(55)** has an circular opening and a semi-circular opening and provides with a protrusion **(551)** characterized in this invention at one spot on surface of the internal wall. The protrusion **(551)** has a fingernail shape, is engaged with an external thread of the lead screw **(51)**, is rubbing on and sliding up the external thread according to rotation of the lead screw **(51)**, and then makes the lead screw **(51)** move linearly along the rotation center axis.

Also, it is preferable that the protrusion **(551)** is a small piece with a half-moon shape or a trapezoidal shape for engaging with an external thread of the lead screw **(51)** in the internal wall surface of the bearing **(55)**. The protrusion **(551)** is provided in the semi-circular opening as shown in FIG. **5**, but may alternatively be provided in the circular opening. In this case, the bearing **(55)** could be embedded in the head lift body **(52)**.

It will readily be understood that the reference numerals enclosed in parentheses are affixed to facilitate understanding of this invention and no more than mere examples and that this invention is not restricted thereto.

As described above, the engaging mechanism of the lead screw and the head lift body is engaging only the fingernail shaped protrusion placed in a spot of the internal wall surface of the bearing portion of the head lift body with the external thread of the lead screw. And rotation moving is converted to linear moving. Accordingly, it is possible by the mechanism above described that accuracy of feeding quantity in the linear movement based on the rotation movement is unrelated to manufacturing accuracy of the bearing portion of the head lift body. As a result, not including the margin of error in the bearing portion of the head lift body, the margin of slippage error against equal feeding quantity depends on only screw accuracy of the lead screw. It is possible to raise the accuracy of feeding quantity.

Accordingly, it is possible to raise the accuracy of feeding quantity during linear movement of the lead screw along the rotation center axis thereof by rotation moving of the lead screw, engaging the protrusion with the external thread of the lead screw.

Moreover, the fingernail shape protrusion is formed into the integral structure by resin molding with the head lift body as the bearing. Accordingly, it is possible not only to improve manufacturing accuracy of the head lift body but to simplify manufacturing administration and to reduce manufacturing cost, also.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a plan view showing a typical tape drive in the state where a top cover is removed;

FIG. **2** is an exploded perspective view of an existing magnetic head actuator assembly;

FIG. **3** is a perspective view of a head feeding mechanism, in an assembled state, illustrated in FIG. **2**;

FIG. **4** is a sectional view of the head feeding mechanism illustrated in FIG. **3**, taken along a line A—A in FIG. **1**;

FIG. **5** is an exploded perspective view of the magnetic head actuator assembly according to an embodiment of this invention;

FIG. **6** is a perspective view of a head feeding mechanism, in an assembled state, illustrated in FIG. **5**;

FIG. **7** is a sectional view of the head feeding mechanism illustrated in FIG. **6**, taken along a line A—A in FIG. **1**;

FIG. **8** is a sectional view taken along a line B—B in FIG. **7**; and

FIG. **9** is a sectional view taken along a line C—C in FIG. **8**.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Now, a preferred embodiment of the present invention will be described with reference to the drawings.

FIG. **5** an exploded perspective view of the magnetic head actuator assembly (hereinafter may simply be called "actuator assembly") according to an embodiment of this invention, which is assembled as assembly **20** in the tape drive shown in FIG. **1**. The actuator assembly comprises a magnetic head assembly **30** similar to the prior one shown in FIG. **2** and a head feeding mechanism **50** according to an embodiment of this invention. The head feeding mechanism **50** comprises a rotation portion and a linear movement portion.

The tape drive **10** for fitting a tape cartridge has been described above referring to FIG. **1** already. The magnetic head assembly **30** also has been described above referring to FIG. **2** already.

Referring to FIGS. **5** to **7**, description will be made of the head feeding mechanism **50**, below.

The rotary movement portion of the head feeding mechanism **50** comprises a lead screw **51** provided with an external thread and a screw central axis as a rotary central axis extending in a linear movement direction. The linear movement portion comprises a head lift body **52** moving up and down in the linear movement direction along the rotation central axis following the rotation of the lead screw **51** and a backlash preventing mechanism **53** for preventing backlash of the actuator assembly **20**.

Difference point of this invention from the existing mechanism shown in FIGS. **2** to **4** exists in the head lift body **52** including a bearing portion **55** engaging with the external thread of the lead screw **51** and will later be described in detail referring to FIG. **8**. The other components are the same as described referring to FIGS. **2** to **4**.

The lead screw **51** is provided with a lead screw gear **54**, which is attached to a lower end thereof for rotating the lead screw **51** around the rotation central axis by means of a drive machine, for example, a step motor or the like.

The head lift body **52** is a component according to this invention and comprises a base portion **521**, a ceiling portion **522**, and a semi-cylindrical portion **523**, which are in an integral structure, preferably, into a single body formed by resin molding. The base portion **521** and the ceiling portion **522** extend in parallel to each other and in vertical to the linear movement direction. The semi-cylindrical portion **523** has an upright gutter-like shape as a half-split cylinder, which is taken by cutting a hollow cylinder by a plane along the center axis thereof, and connects between and supports the base portion **521** and the ceiling portion **522**. Accordingly, the head lift body **52** has a generally "I" shape as seen from a lateral side. The head lift body **52** holds the magnetic head assembly **30** and moves linearly up and down together with the magnetic head assembly **30**. In the head lift body **52**, the backlash preventing mechanism **53** is arranged inside of the semi-cylindrical portion **523**.

The backlash preventing mechanism **53** prevents backlash of the actuator assembly **20** as described above.

The lead screw gear **54** makes the lead screw **51** rotate along the rotation central axis by means of, for example, the step motor as described above. The rotation of the lead screw **51** around the rotation central axis thereof makes the head lift body **52** move in the linear movement direction coincident with the rotation center axis, in cooperation with the backlash preventing mechanism **53**.

As described above, the head lift body **52** comprises the base portion **521** defining a lower end surface, the ceiling portion **522** defining an upper end surface, and the semi-cylindrical portion **523** with the hollow opening, and has an integral single body structure formed by resin molding. The base portion **521** has a bearing portion **55** (described later) and a guide portion **57**, and the ceiling portion **522** has a plain or sliding bearing **56**. The bearing portion **55**, the sliding bearing **56**, and the semi-cylindrical portion **523** are used for receiving the lead screw **51** inserted therethrough.

The base portion **521** is provided with the bearing portion **55**, which comprises a half-cylindrical projection **55*a*** coaxially disposed in the semi-cylindrical portion **523** and a circular opening **55*b*** continuous to the half-cylindrical surface of the half-cylindrical projection **55*a***. The half-cylindrical projection **55*a*** has a fingernail shaped protrusion **551** on its inner surface. The protrusion **551** engages the external thread of the lead screw **51** inserted through the bearing portion **55** and the plain bearing **56**.

In the embodiment shown, the bearing portion **55** is illustrated to have the half-cylindrical projection extending on the upper-side of the base portion **521**. This is convenient for burying the protrusion **551** onto the internal wall surface of the bearing **55**. Alternatively, it is possible that the protrusion **551** may be buried on the inner wall of the circular opening **55*b***. In this case, the protrusion **551** may be formed to an integral structure with the base portion **521**. Further, the bearing portion **55** may only be formed by the circular opening without formation of the half-cylindrical projection **55*a***.

One of the peaks of the base portion **521** laterally extends as an arm to the length longer than the other peak and has the guide portion **57** of a generally "U" shape at its end. The guide portion **57** is fitted and attached to the guide bar **17** illustrated in FIG. **1** so as to be slidable in the vertical direction. The guide portion **57** serves to prevent the rotation of the head lift body **52** around the rotation central axis of the lead screw **51**.

The ceiling portion **522** has a pair of screw holes in its peaks engaged with the screws (not shown), respectively. By screwing the screws into the screw holes, the magnetic head assembly **30** is fixed to the head lift body **52**.

The inner hollow portion of the semi-cylindrical portion **523** serves to receive the backlash preventing mechanism **53** comprising a pre-load bushing **531** and a pre-load spring **532**.

In the backlash preventing mechanism **53**, the pre-load bushing **531** comprises a cylindrical portion with an internal thread formed on its inside surface, an external annular receiving portion, and a semi-cylindrical wall portion. The external annular receiving portion extends radially outward at the lower end of the cylindrical portion to serve as a stopper for the pre-load spring **532**. The semi-cylindrical wall portion extends upward from an outer periphery of the receiving portion in an area corresponding to a general half circle. Accordingly, a semi-annular gap is formed between the cylindrical portion and the semi-cylindrical wall portion.

As shown in FIG. **6**, the pre-load spring **532** is partially received in the semi-annular gap and is disposed in a compressed state between the annular receiving portion of the pre-load bushing **531** and the lower surface of the ceiling portion **522** of the head lift body **52**. Furthermore, both ends of the semi-cylindrical wall portion of the pre-load bushing **531** inhibit the rotation of the pre-load bushing **531** by engagement with edges of the semi-cylindrical portion **523** when the pre-load bushing **531** is mounted into the head feeding mechanism **50**.

The pre-load spring **532** comprises a compression coil spring. By the pre-load spring **532**, the pre-load bushing **531** is continuously applied with a downward pressing force along the rotation center axis of the lead screw **51** on one hand. On the other hand, the head lift body **52** is continuously applied with an upward pressing force along the rotation center axis of the lead screw **51**. As the guide portion **57** is integrally formed with the head lift body **52**, the guide portion **57** is continuously applied with the upward pressing force along the rotation center axis of the lead screw **51**, also.

Next, referring to FIGS. **6** to **9**, description will be made of the bearing portion **55** formed in a part of the head lift body **52** characterizing this invention.

As described above and shown in the figures, the bearing portion **55** with the fingernail shaped protrusion **551** is included in the base portion **521**, which is formed in one body by resin molding together with the ceiling portion **522** and the semi-cylindrical portion **523**. And the bearing portion **55** has the half-cylindrical projection **55***a* the circular opening **55***b* and receives the lead screw **51** inserted therethrough.

The protrusion **551** can be a pin like protrusion or a plate like protrusion, which projects from the internal wall surface of the half-cylindrical projection **55***a* toward the central axis of the bearing portion **55**. The plate like protrusion **551** is formed in a half-moon shape or a trapezoidal shape having a linear edge at its projecting end and is disposed on the inner wall of the half-cylindrical projection **55***a* with an inclination equal to an inclined angle of the external thread of the lead screw **51** with respect to a plane perpendicular to the rotation axis of the lead screw **51**. Thus, the half-moon shaped plate-like protrusion **551** can be engaged with the external thread of the lead screw **51** screwed through the plain bearing **56**. Accordingly, it is possible for the fingernail shaped protrusion **551** to trace, rub on and slide up the external thread of the lead screw **51** following the rotation thereof, and then makes the head lift body **52** move linearly along the rotation center axis of the lead screw **51**.

Namely, the above-described engaging structure between the lead screw **51** and the head lift body **52** converts the rotation movement of the lead screw **51** to the linear movement of the head lift body **52**. In the structure, the external thread of the lead screw **51** engages with one protrusion **551** on the internal wall of the bearing portion **55** in the head lift body **52**. Accordingly, manufacturing accuracy in the bearing portion **55** of the head lift body **52** is unnecessary but screw accuracy of the lead screw **51** is only necessary for insuring feeding accuracy of the head lift body **52**.

Furthermore, the protrusion **551** can be formed into one integral body with the head lift body **52**, the head feeding mechanism is simplified in the manufacture administration and is reduced in the manufacturing cost.

It is necessary for the fingernail shaped protrusion **551** to have strength as much as the fingernail shaped protrusion **551** endures loading of the head lift body **52** accompanied by rotation of the lead screw **51** and spring pressure of the backlash preventing mechanism **53**.

Accordingly, if the protrusion could keep such strength, the protrusion can move the head lift body in the direction of rotation axis following the rotation of the lead screw engaging with the external thread of the lead screw. That is, the protrusion as keep such strength is not limited to the fingernail in the shape but can have another shape such as trapezoid.

The protrusion is not formed in one integral structure with the head lift body, but can be formed to a separated one and fixed to the internal wall of the bearing portion in the head lift body. In this case, it can strengthen more the protrusion by selecting the material and the shape thereof.

While the present invention has been described in detail in conjunction with the preferred embodiment thereof, the present invention is not limited to the foregoing description but can be modified in various manners without departing from the scope of the invention set forth in appended claims. For example, the components except above protrusion, such as semi-cylindrical portion of the head lift body may have any polygonal cylindrical shape as far as molding is possible or may comprise a plurality of columnar portions.

What is claimed is:

1. A head feeding mechanism for linearly moving a head assembly along guide bar arranged on a housing and extending in a linear movement direction of said magnetic head assembly, said head feeding mechanism comprising:

- a lead screw having an external thread formed on an outer surface thereof and a screw center axis extending in parallel to said linear direction, said lead screw being rotatable around said screw center axis by a drive machine;
- a head lift body for supporting said head assembly, which is mounted on the head lift body, and having a bearing portion for receiving said lead screw, which extends in the bearing portion; and
- a protrusion projecting from an internal wall surface of said bearing portion so as to engage with said external thread of said lead screw, such that said protrusion slides up and down alone said external thread following rotation of said lead screw, so as to move said head lift body linearly alone said screw center axis;

wherein said head lift body comprises:

- a base portion comprising said bearing portion having said protrusion;
- a ceiling portion extending in parallel with the base portion and comprising a ceiling side bearing portion receiving said lead screw, and
- a column portion connecting said base portion and said ceiling portion and comprising a hallow portion receiving said lead screw; and

wherein said column portion comprises a semi-cylindrical portion partially surrounding said lead screw.

2. A head feeding mechanism as claimed in claim **1**, wherein said protrusion comprises a plate protrusion, and said plate protrusion is disposed with an inclined angle equal to an inclination of the external thread of said lead screw with respect to a plane perpendicular to said screw central axis.

3. A head feeding mechanism as claimed in claim **2**, wherein said plate protrusion is formed into a half-moon shaped plate having a linear edge at a projecting end thereof.

4. The head feeding mechanism as claimed in claim **1**, wherein said protrusion is formed together with said bearing portion into a single body by resin molding.

5. The head feeding mechanism as claimed in claim **1**, wherein said bearing portion formed in said base portion comprises (i) a half-cylindrical projection projecting from an upper surface of said base portion at a position on an interior side of said semi-cylindrical portion, (ii) and a circular opening formed an said base portion continuously from a half-cylindrical surface of said half-cylindrical projection.

6. The head feeding mechanism as claimed in claim **5**, wherein said protrusion is disposed on an inner surface of said half-cylindrical projection.

7. The head feeding mechanism as claimed in claim **6**, wherein said protrusion is embedded on the inner surface of said half-cylindrical projection.

8. The head feeding mechanism as claimed in claim **6**, wherein said base portion, said ceiling portion and said semi-cylindrical portion are formed in a single body by resin molding.

9. The head feeding mechanism as claimed in claim **8**, wherein said protrusion is formed integrally with said base portion.

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